# APPENDIX A

## Analysis of Time-Lapse Seismic Technology Using a Physical Model of a Porous Channel Sand

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Excerpt, pgs. 16-17

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### III.1.1 Porous channel sand

Workers in rock physics have constructed porous sand models in several research laboratories. Gik (1997) used foam plastic grains distributed in resin to imitate the pores. Molyneux and Schmitt (1999) mixed glass beads with quartz sand for a compressional wave velocity study in attenuating media. Winkler (1983) compared the velocity dispersion and attenuation factor of some sandstone samples with more homogeneous sintered glass beads. Continuing this work, sandstone analogs made from sintered glass beads with porosity ranging between 1 % and 43 % were tested to establish a relationship between ultrasonic velocity and porosity (Berge et al., 1995). Sherlock (1999) used sorted sand to study the influence of fluid migration pathway in combination with buoyancy and hydrodynamic flow, which finally can be mapped in 3-D reservoir images. Following Berge et al. (1995), I expect sintered glass beads to provide an excellent means of conducting a time-lapse seismic modeling experiment. I am able to control the porosity and permeability by choosing bead size and heating history. Baking the glass beads in a kiln at 700°C for 15 minutes creates good contact or cementation between the grains while maintaining connectivity between the pores. Despite the imperfect grain size scaling that falls around $\alpha = 20$ cm (after applying the 10,000:1 scale), using another material with smaller grain size gives rise to strong capillary effects we do not wish to model.

The specifications of glass beads used are as follows:

Product name : Glas-Shot

Composition : $SiO_2$ (71-74%), $Na_2O$ (12-15%), CaO (8-10%), MgO (1.5- 3.8%), $Al_2O_3$ (0.2-1.5%), $K_2O$ (0-0.2%), $Fe_2O_3$ (0-Trace).

Density : 2.42 – 2.50 g/$cm_3$

Melting temperature : 730 °C

Manufacturer : Cataphote Inc., Jackson, MS, USA.

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One of the uses of glass beads is in the construction of simple cylindrical filters used in the beverage processing industry.